

REPORT DOCUMENTATION PAGE

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08 Mar 2001

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-VG-2001-049**
Liu, C.T., "Predicting the Initial Crack Length in a Solid Propellant" (VuGraphs)

JANNAF 34th Structures & Mechanical Behavior Subcommittee Meeting
(Cocoa Beach, FL, 26-30 Mar 2001) (Deadline: 22 Mar 2001)

(Statement A)

Predicting the Initial Crack length in a Solid Propellant



Dr. C. T. Liu

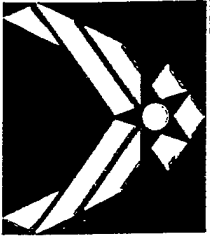
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Dr. Y. G. Kwon

Naval Postgraduate School

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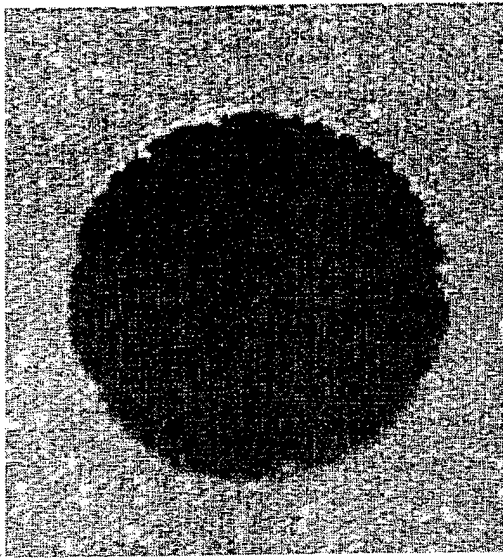
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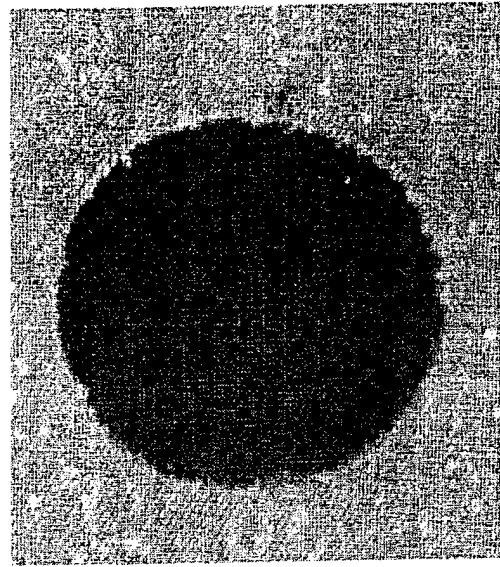
Objective



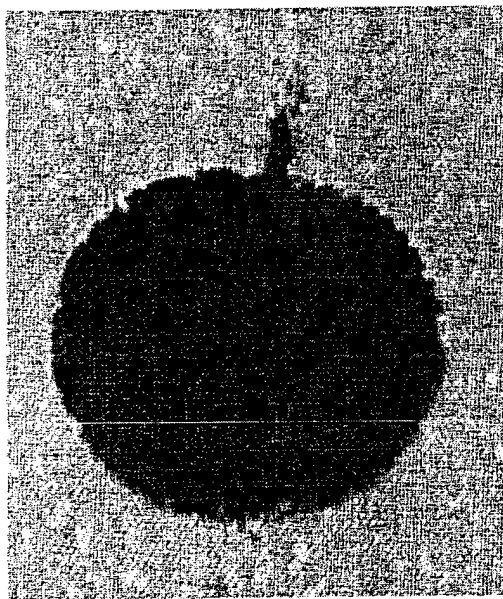
- Predict the Initial Crack lengths in High Stress Regions in a Solid Propellant



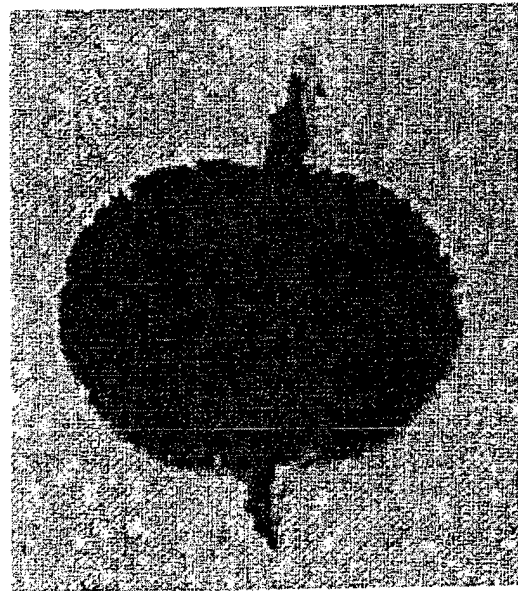
(a)



(b)



(c)

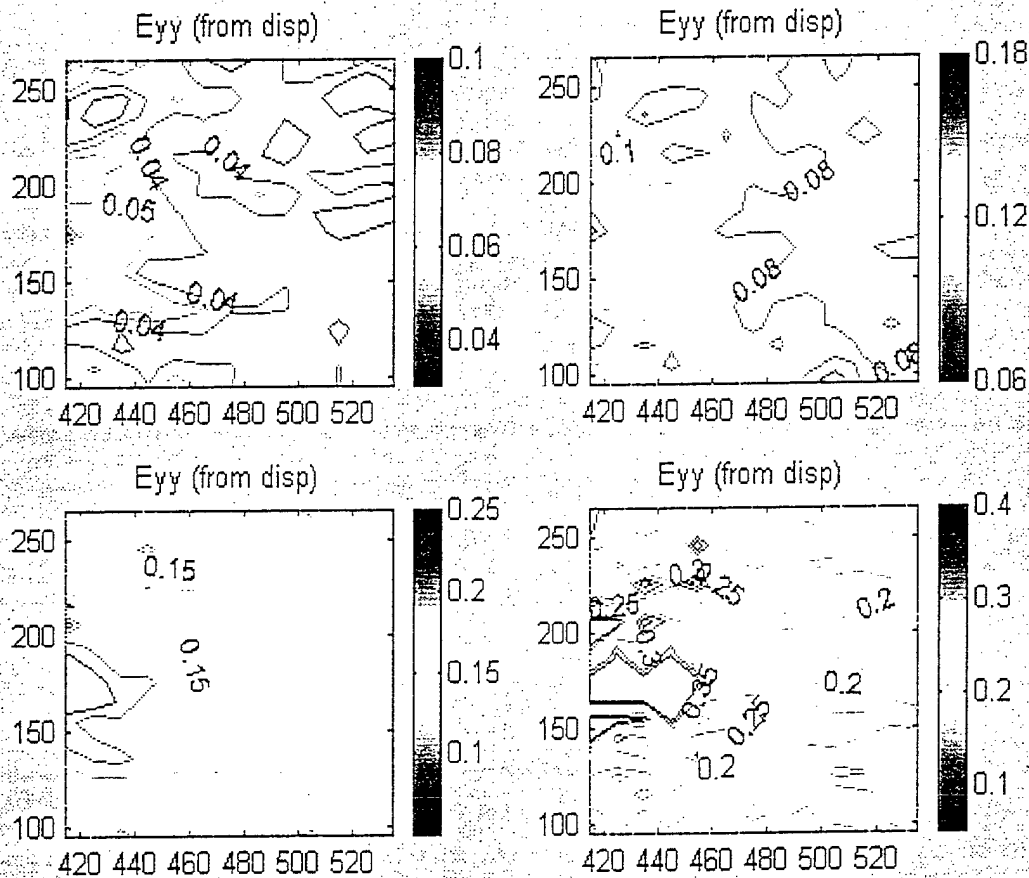


(d)

Figure Formation of Initial Cracks at the Notch Tip: Increase in Applied Load from (a) to (d)

Contour Plots of Normal Strain in the Vertical Direction (ϵ_{yy})
(Obtained from displacement fields)

Video 1



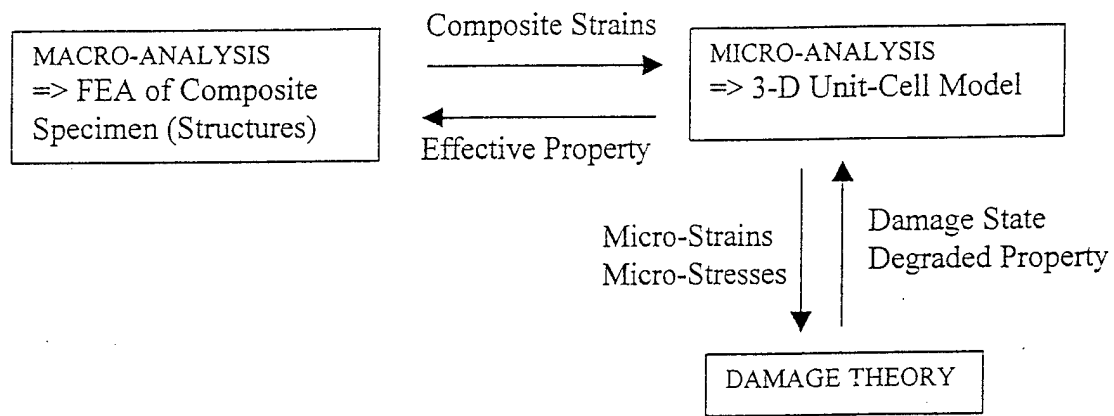


Figure Interaction between Micro-analysis and Macro-analysis

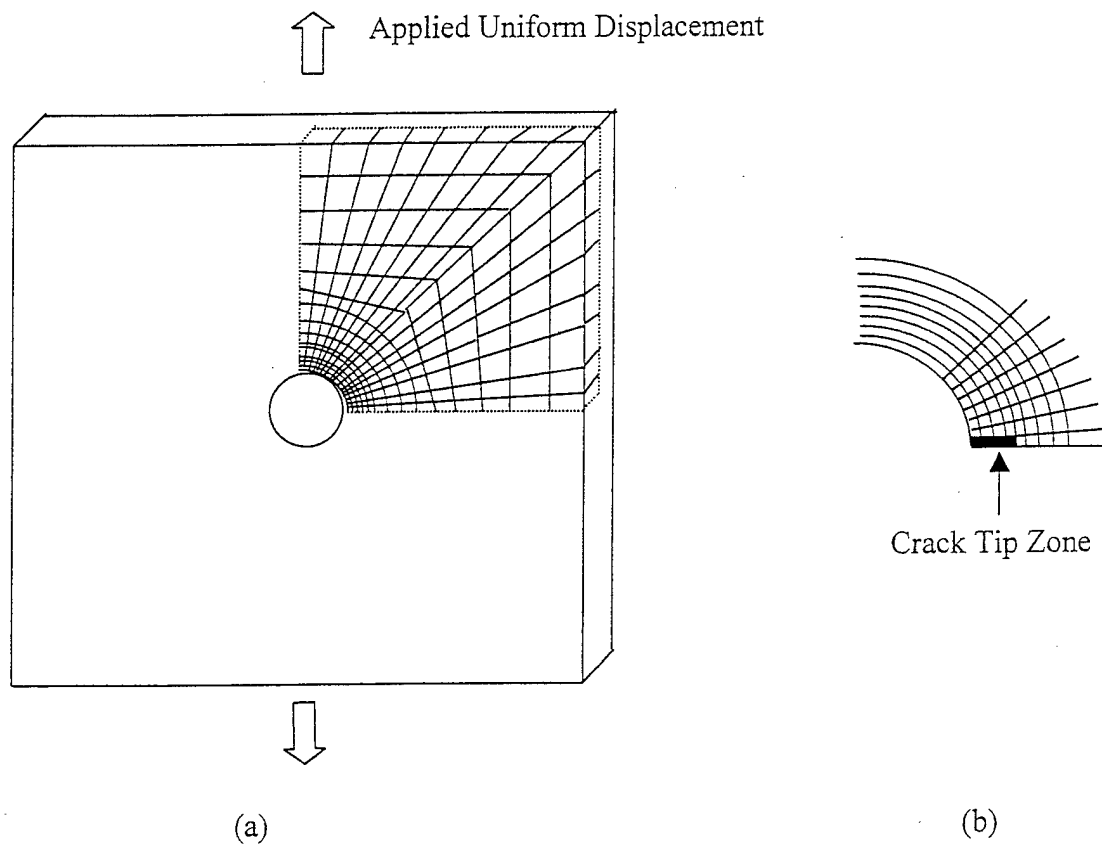
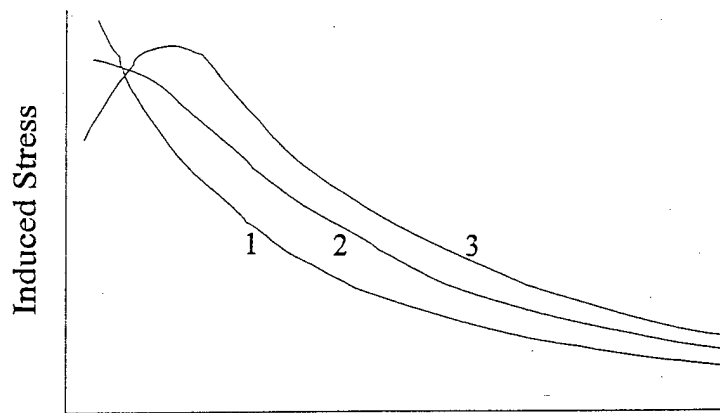
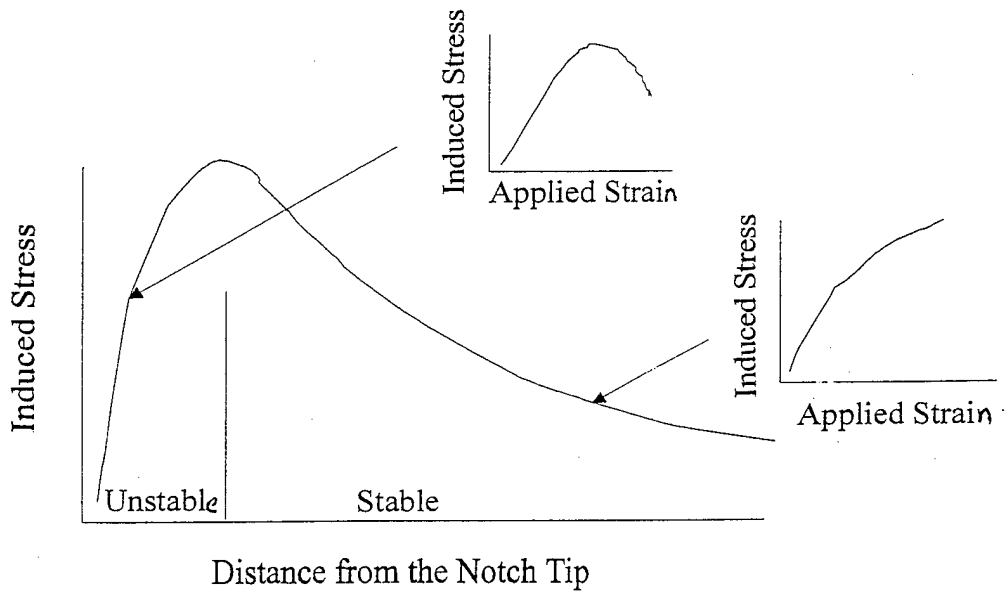


Figure Specimen Geometry and Finite Element Mesh: (a) Plate of 76.2 mm x 76.2 mm x 6.35 mm with a hole of radius 6.35 mm, (b) Enlarged View near the Notch Tip



Distance from the Notch Tip

(a)



(b)

Figure Stress Distribution along the Minimum Section from the Notch Tip as a function of damage: (a) Damage Increases from Curve 1 to Curve 3, (b) Stable and Unstable Zones when Damage Saturates at the Notch Tip

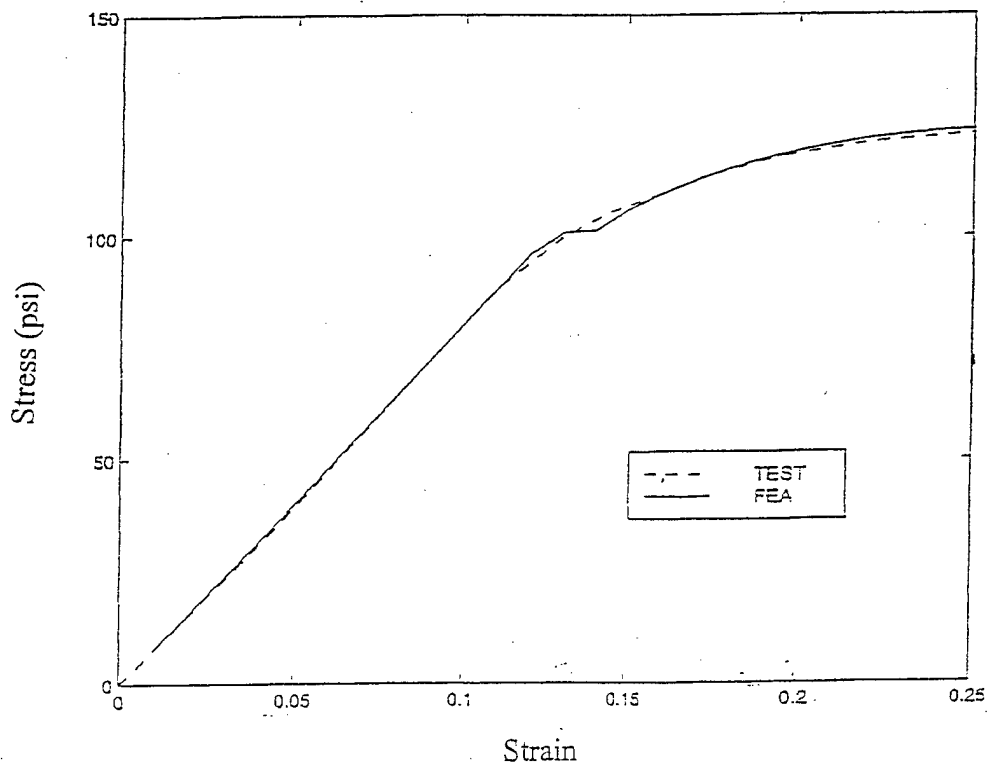


Figure Stress-Strain Curves.

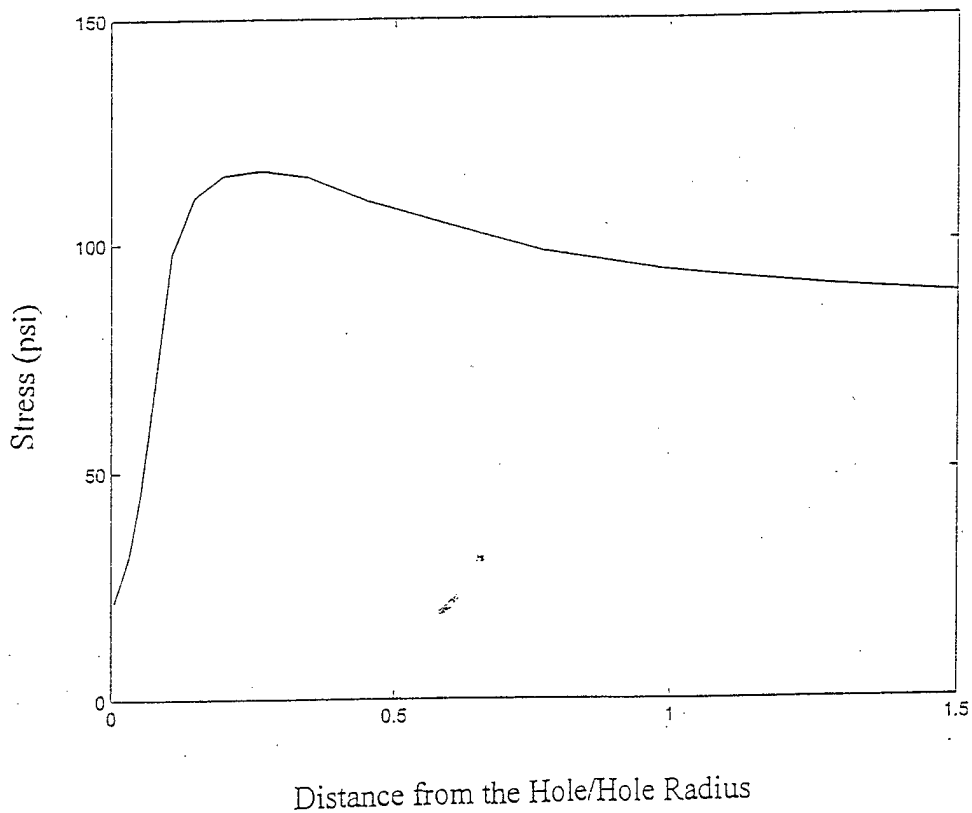


Figure Normal Stress Distribution as a Function of the Normalized Distance from the Edge of the Hole (0.5 in Hole Diameter).

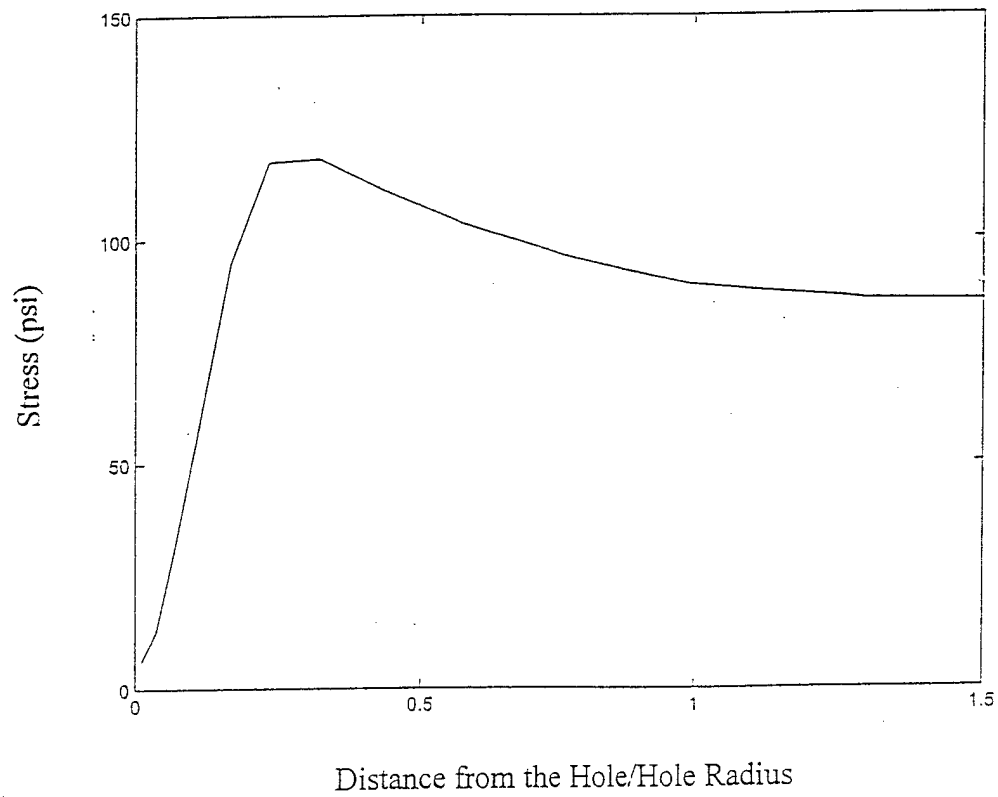
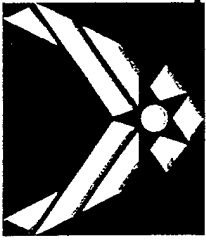


Figure Normal Stress Distribution as a Function of the Normalized Distance from the Edge of the Hole (0.25 in Hole Diameter).



Conclusions



- A technique ^{was} is developed, based on a micro-macro approach and a stress instability criterion, to predict the initial crack length in a high stress region.
- The predicted and the measured average initial crack lengths are 0.0242 in. and 0.0307 in for $D = 0.25$ in. hole and 0.0489 in. and 0.0526 in for $D = 0.5$ in. hole.